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Forms of Innovation Inspired by Open Educational Resources: A Post-Project Analysis

Tim Coughlan, Beck Pitt and Rob Farrow

Institute of Educational Technology, The Open University UK

Abstract

It has been argued that Open Educational Resources (OER) present opportunities for innovation in education. However, there has been a lack of retrospective analysis of the forms of innovation that can emerge through OER, and the processes and challenges these entail. This paper presents a post-project analysis of the diverse uses and impacts of open courses produced through an international OER initiative. A thematic analysis of retrospective interviews and documentation from this case study is reported on, guided by a review of relevant concepts from innovation and OER literature. Through this we identify three archetypal forms through which the OER created opportunities for innovation: Specific Adoption; Preferred Practice; and Foundations for Innovation. We identify drivers and inhibitors through which these forms of innovation interacted with each other in this initiative. This elaborates on the notion that a single existing model does not capture the multi-faceted relationships between innovation and OER.

Keywords: OER; innovation; impact; qualitative; open education

Introduction

Open Educational Resources (OER) are “teaching, learning and research materials in any medium – digital or otherwise – that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions” (Hewlett Foundation, 2018). OER has regularly been associated with innovation in education (Casserly & Smith, 2008; Lane, 2010; Orr, Rimini & van Damme, 2015) and the widely-signed Cape Town Open Education Declaration states that OER and related practices will “accelerate innovation in teaching” (Cape Town Open Education Declaration, 2008). However, innovation occurs through complex long-term processes (Van de Ven, 1986; Rogers, 2010), and our understanding of the relationships between innovation and OER appears to be limited by factors including the varied contexts in which OER are used, and the flexible and mutable nature of OER.

This deficit of understanding also reflects the developmental trajectory of OER as a loosely organised concept and movement. Research in the area has prioritised understanding and awareness of well-defined potential benefits, such as reduced costs and parity of effectiveness (for example, Hilton, 2016). Normative arguments relating to the potential of OER and open practices are still without clear definition or a persuasive evidence base, and evaluation of the impact of OER is still developing (see

Weller, 2016). Data are often only captured during project life, so analysis around diffuse processes such as innovation is lacking. There is, therefore, a need for longitudinal case studies to bring balance with regards to the opportunities and challenges of OER (Weller, de los Arcos, Farrow, Pitt, & McAndrew, 2015), and to understand where and how OER can support innovation.

This paper explores and imposes types on the diverse forms that OER-based innovations can take. We ground this process in a retrospective case study of the longer-term impacts of a collaborative, international OER initiative: Bridge to Success (hereafter B2S), and identify how such an initiative instantiates – or differs from – recognised features of innovation processes.

We identify how concepts from prior research on innovation intertwine with instances of use of the OER produced by the initiative, and define three interrelated forms of innovation occurring around OER. These provide a basis for identification of drivers and inhibitors of OER-based innovation. Those planning, managing, or evaluating OER projects could reuse or extend this model to interrogate if and how an OER initiative can result in innovations such as pedagogical or organisational change.

Background

This section describes several conceptualisations of innovation, and explores some of the ways OER and open practices are considered to be innovative.

Understanding Innovation

Innovation can be defined as “the development and implementation of new ideas by people who over time engage in transactions with others within an institutional order”. As such, innovation ties together creative thinking with processes of implementation and impacts that emerge over long time periods and relate to social structures (Van de Ven, 1986). A dominant perspective in innovation research is that outlined in the Diffusion of Innovations model (Rogers, 2010). Rogers models the adoption of an innovation by individuals or organisations, with the sequential steps of Knowledge; Persuasion; Decision; Implementation and Confirmation. He argues that the following attributes affect decisions by individuals or organisations to adopt innovations:

- *Relative advantage*: Whether an innovation is perceived as better than the idea it supersedes.
- *Compatibility with pre-existing systems*: Including values and experiences of potential adopters as well as their needs.
- *Complexity/difficulty to learn*: Simple ideas are easier to adopt, while others require new skills and understanding.
- *Trial/testability*: The potential for experimenting with the innovation on a limited basis
- *Observed effects*: How results of the innovation are visible to others, adding to the likelihood that they will also adopt the innovation.

Rogers also provides a conceptualisation of the paths and rate of innovation adoption,

including well-used definitions of groups of adopters, from a small number of innovators who take the innovation up immediately, through a larger group of early adopters, on to the early and late majority, and the 'laggards' who delay adoption even further. Importantly, Rogers also considers how social structures add complexity to this diffusion process; it is noted that organisational decisions to adopt could be made by consensus, or by top-down authority. It is argued that particular groups of adopters are influenced differently, for example, that opinion leaders may hold particular influence on later adopting groups. The model aims for general applicability and understanding of innovation. This generalisability may, however, mean that the nuances of any particular innovation, or of the social system in which it exists, are not well represented.

In education, innovation may be defined as the impact of new ideas – whether constituting a product, service, or process – on the goals of educational institutions (Kalman, 2016). A conceptualisation of educational innovation that has been considered relevant to OER is the Substitution, Augmentation, Modification, Redefinition model (SAMR) (Puentedura, 2006, cited in Orr *et al.*, 2015). Rather than describing decision-making or rate of adoption in the way that the Diffusion of Innovations model does, SAMR distinguishes four types of changes that can be achieved through the introduction of new technologies:

- *Substitution*: The technology replaces a similar learning material allowing for the same functionalities.
- *Augmentation*: The technology constitutes an improvement in terms of previous learning materials' efficacy.
- *Modification*: The technology enables a substantial learning activity redesign compared to the previous learning material.
- *Redefinition*: The technology allows for new forms of learning that were previously unavailable within the teaching and learning configuration.

The distinguishing factor between each stage is the extent to which the new technology changes the learning task. These positive conceptions of change to an activity can also be linked to the *relative advantage* component of Rogers (2010). Both concern the individual or organisational rationale for adoption. While the SAMR model has gained popularity, there is a lack of peer-reviewed evaluation research explaining its derivation (Green, 2014). As such, its only claim to validity can be that these distinctions in how technology can change activity have been found useful by practitioners.

Relationships between changes in technology and activity are captured more broadly in the Task-Artefact Cycle (Carroll, Kellogg & Rosson, 1991), which represents the iterative process through which new technological artefacts are adopted, affording new possibilities for tasks that people perform. This leads to further requirements to iterate the technological artefacts and continuing co-evolution with tasks in a cyclical process. Thus, a technological innovation is, from this alternative perspective, itself under continuing development, and this development should be partly directed by the adopters themselves.

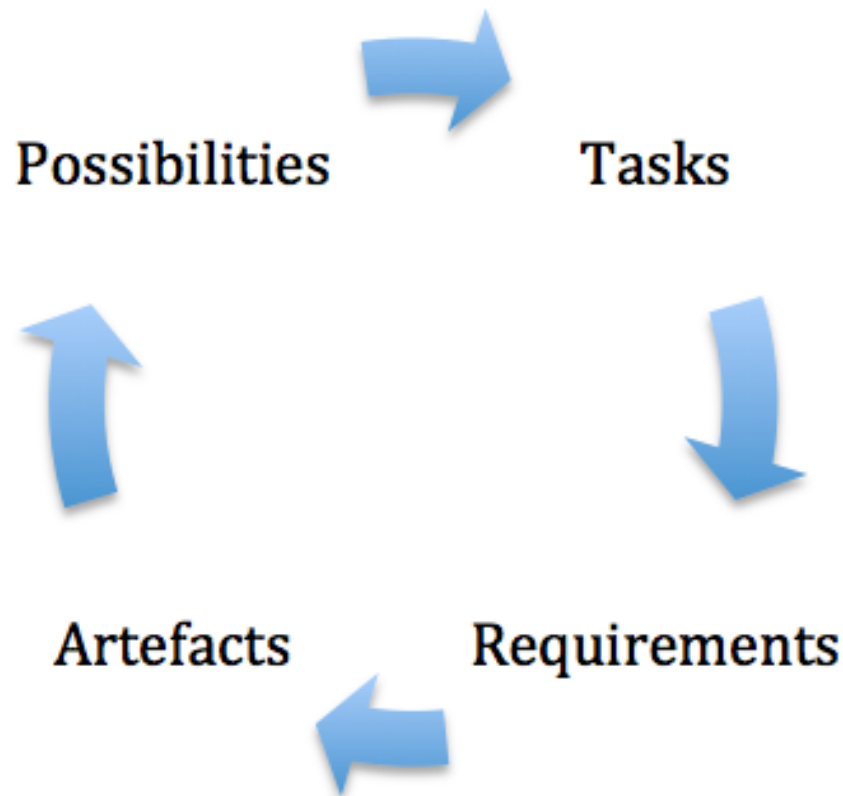


Figure 1. The Task-Artefact Cycle. Adapted from Carroll et al. 1991.

While technology can be viewed as a natural driver of innovation in education, this relationship is not straightforward and the idealised task-artefact cycle often faces barriers and hidden complexity. For example, Weller (2009) highlights conflict between the structures of a learning management system (LMS) and potential innovations that online pedagogies could support. As the LMS recreates the structures of a traditional classroom, it can also reinforce existing assumptions, power relations and habits, acting as a barrier to innovations, such as personalisation, the expansion of curricula, or informal learning. Therefore, envisaged innovations are restricted where designed artefacts embody pre-existing worldviews and lack the plasticity to be adapted to new tasks.

Innovation and OER

A conceptual challenge in examining OER and innovation is that OER by definition does not specify a single form, or mechanism of delivery (Creative Commons, 2016). In this sense it is an evolving assemblage of resources and legal, technological, and social infrastructure. The flexible and shifting nature of openness could result in more freedom for organisations and individuals (Farrow, 2016; Farrow, 2015). But how do these affordances actually lead to innovation in learning and teaching practices?

Casserly and Smith (2008) argue that OER could change teaching and learning practice due to the wider availability of high-quality resources. Educators widely report the use of OER to broaden their teaching methods, gather inspiration, and source

materials for students (OER Research Hub, 2015). Lane (2010) argues that: “[o]penness provides an invitation to innovate, even if it is only to learn in a different way”.

Concepts from Rogers’ (2010) model of innovation have notably been applied in open education by Arendt and Shelton (2009) to analyse OpenCourseWare and identify incentives and disincentives for adoption. Major incentives for adoption included the lack of financial cost and the ubiquitous availability of OER. Disincentives included a lack of accreditation and of professional guidance for educators. Innovations within the OER space to overcome these disincentives have since developed. For example, many organisations have made plans to award college credit for OER or MOOC study (Saylor, 2016; OERu, 2016). Further barriers to the adoption of OER include a lack of understanding of the legal considerations, and of time and skills (de Hart, Chetty & Archer, 2015); a lack of discoverability of suitable resources and repositories (OER Research Hub, 2015); and institutional concerns of reputation, quality or loss of control over assets (Annand, 2015).

A further perspective on innovation and OER has been drawn by following the notion in Rogers’ (2010) work that there are distinct categories of people who adopt or resist innovations over time. Jhangiani (2017) highlights the popular application to OER of a ‘pencil metaphor’ of six adoption groups for educational technologies, which positions many of the themes raised by Rogers (2010) in an educational context. Jhangiani (2017) also notes that alternatively, data can be used to categorise OER users according to their practices, for example as ‘OER active’, ‘OER as facilitator’ and ‘OER consumer’ (Weller, de los Arcos, Farrow, Pitt & McAndrew, 2016). They conclude that however they are categorised, educators have diverse needs, can focus on pragmatic or idealistic rationales for their choices, and could evolve into different groups over time by gaining familiarity and skills with OER.

Open Practices and Organisational Cultures

The concept of “Open Innovation” (OI) suggests that the boundaries of an organisation should not restrict the flow of ideas, nor impede routes to innovative outcomes. In contrast to internally-protective research and development, external sources should be drawn on, and intra-organisational partnerships created to support cross-fertilisation (Chesborough, 2006). While education has particular characteristics, the forces that have led to the growth of OI in other industries are largely applicable. These include a desire for agility and flexibility to adapt to rapid changes in technology, globalisation, and business models (Gassman, 2006). Lane (2010) suggests that OER can spread pedagogical, technological and subject knowledge between educational organisations.

The use of OER often occurs against a backdrop of closed institutional processes. Rolfe (2015) highlights how the sustainability of OER practices is linked with organisational change, finding that the short-term, funded-project nature of many OER initiatives creates forward “lurches”, which then require the continued presence of “champions” who drive the open practices developed through the initiative. This coheres with the findings of Annand (2015) who argues that the benefits of OER perceived by governments and individuals often meet with institutional resistance and inertia. A reasonable parallel may be drawn with software development, where it has been observed that the use of open source software by proprietary companies now

requires software developers to consider how their activities create value both within the organisation and in the wider “open” commons (Rolandsson, Bergquist & Ljungberg, 2011).

Open Educational Practices (OEP) have emerged that enhance curriculum through reusing or adapting OER during the design and delivery of learning (Armellini & Nie, 2013). In this way, OER may provide a basis for ‘little-c’ creative acts (Craft, 2001): pockets of innovation in teaching which result from the agency, drive and creativity of educators. OER can be viewed to afford freedoms through which teachers and learners can pursue greater realisation of their interests. However, the competencies required for individuals to effectively utilise openness as a means to change remain under-defined (Deimann & Farrow, 2013).

Summary

The literature described above provides concepts to consider in the analysis of innovation inspired by an OER initiative. Several perspectives are covered: Rogers describes the spread and adoption of an innovation; the SAMR model is focused on the ways in which the introduction of an educational technology changes learning activities. Further literature highlights critical OER-specific factors. OER can be perceived as an innovation in themselves (e.g. using open materials rather than closed), and as a catalyst for other forms of pedagogical innovation. OER are not themselves a technology, but are supported by many technologies (e.g. open licences). The use of OER appears driven primarily by individuals and initiatives, but is sustained and spread by traction in organisational contexts.

Case Study: The Bridge to Success Initiative

We analyse a specific, bounded case study (Cohen, Manion & Morrison, 2000) of OER development and use: Bridge to Success (B2S). Between 2011 and 2012, B2S produced whole-course OER to prepare adults in the US to transition to college-level learning. The partners in the project were a US-based public university (College 1), a large US-based community college (College 2), and a UK-based distance learning university (University 2), with support from a US-based private research university (who are not considered as a user of the courses for this analysis).

B2S took as its starting point two existing distance-learning courses on mathematics and study skills, written in the UK and released as OER after several years of use. The courses were designed to build confidence in learning skills and mathematics in students as a foundation for those who may not be sufficiently prepared for higher education. Similar challenges were identified in the US context, so the OER were adapted for a US audience by a trans-Atlantic team. This form of cross-institutional, and cross-cultural, collaboration was considered by the project team to support the sharing of ideas and knowledge (Coughlan, Pitt & McAndrew, 2013).

The core OER produced by the project were:

- *Learning to Learn* (L2L): A study skills course to build confidence and develop learning skills via practical and reflective activities.

- *Succeed with Math* (SWiM): An introductory mathematics course covering key pre-algebra concepts with real world applications.

L2L was publically released in September 2011, and SWiM in February 2012. From September 2011 until the project end (July 2012), the courses received 5,056 unique visitors. The courses have been reused and remixed since the end of the project. While they are still available in their original form, they have been superseded by remixed versions (as discussed in the analysis section). Table 1 identifies diverse uses by a range of US-based institutions, including colleges and universities with face-to-face and distance learning approaches, and non-profit institutions with education and training activities. The uses of the OER ranged from individual staff taking specific activities or components out of the courses, through to encouraging completion of courses as a standard intervention for students across an institution who were identified to be struggling in their current studies.

Strengths and Limitations

As a case study through which to understand innovation and OER, B2S has strengths through the many diverse instances of implementation across colleges, universities, and the educational initiatives of non-profit organisations. The two resources also differ in their subject matter and content. Our study is also based around a well-resourced, fixed-length project; a fairly typical model for OER initiatives. Conversely, there will always be limitations of generalisability with any particular case, and like all case studies, this one is located in a particular context at a specific historical point. Here it should be particularly noted that both OER are lengthy courses, aimed at similar audiences. The cross-organisational collaboration provides additional potential for innovation, but also challenges of translation between processes and curricula.

It has been noted that OER as a movement and innovation is in a state of evolution, and conversely that time must pass in order to understand innovation as a diffuse longitudinal process. In this case, the project also took place at a relatively early phase of OER implementation at scale in the USA, where infrastructure had been developed programmatically but adoptions at scale, policy initiatives and general awareness of OER were less advanced than at present (Bliss & Smith, 2017).

Method

For this post-project analysis, 12 organisations were identified that had made subsequent use of the OER produced for B2S. Between 2012 and 2014, researchers conducted interviews with educators who had used the OER from these institutions, wherever possible. The interviews elicited reflections and understanding of impacts that could only occur when time has passed after the initial engagement. We also reviewed project documentation and engaged in retrospective discussions with project staff, including particularly, the project manager.

A total of 20 participants took part in interviews or focus groups across 7 of the 12 identified institutions. The institutions identified, their use of the OER, and the data collections achieved is described in Table 1. This followed an initial set of 38 interviews with project partners and staff conducted during the project, which provide

background to initial aims and activities. All interviews were semi-structured. The first set of interviews focused on the development of the OER and the early stages of its use. The second set of interviews asked interviewees, representing the diverse range of institutions who had used the B2S resources, to retrospectively explore the reuse of the OER, using questions based around a set of identified challenges for the OER movement (McAndrew, Farrow, Law & Elliot-Cirigottis, 2012). While the first set of interviews provide contextual understanding, the second set of interviews are the main focus of this paper.

Table 1. Institutions identified as having engaged with the Bridge to Success OER for the purposes of the retrospective research project

Institution	Description of Institution	Uses	Post-project data collection
College 1	Public four-year university college focused on distance learning. ~90,000 enrolled students.	Use of SWiM and L2L in relevant courses.	3 interviews (2 educators, Dean)
College 2	Public two-year campus-based college. ~50,000 enrolled students.	Use of L2L in study skills course and SWiM as an additional online tutoring programme.	Focus group (3 educators) and 2 individual interviews (researcher and dean)
College 3	Campus-based community college with some online classes ~10,000 enrolled students.	L2L used in 'Moving up a level' course	N/A
College 4	Technical college with multiple campuses and some online classes. ~14,000 enrolled students.	SWiM used for as part of a medical assistance training programme	Joint interview (2 educators)
College 5	Campus-based community college with distance learning options. ~44,000 enrolled students.	SWiM and L2L used in a workforce development program.	N/A
College 6	Campus-based two	Use of SWiM.	N/A

	and four year community college. ~6,000 enrolled students.		
College 7	Community college with multiple campuses and some online courses. ~70,000 enrolled students.	Use of SWiM as a supplement advertised to students.	5 interviews (project manager, 3 educators, student)
University 1	Public campus-based university. ~6,000 enrolled students.	Use of L2L in an introduction to higher education course	1 interview (educator)
University 2	Public open access distance learning university. ~175,000 enrolled students.	Original creators of the resource. New forms of open courses were created with added accreditation, based on the remixed versions of the B2S courses.	Email exchanges and discussions with key staff.
Non-profit 1	Local arm of a charitable organisation aiming to prepare people to gain employment and be independent.	Units of SWiM used to support those aiming to pass an entry examination for a work training programme.	2 interviews (1 instructor & joint interview with 2 senior team members)
Non-profit 2	Family centre aiming to support parents from disadvantaged backgrounds.	L2L and SWiM introduced to a computer lab supporting single parents into formal education.	1 interview (centre director)
Governmental Agency 1	Administrative agency that funds training programs to improve employment opportunities.	L2L and SWiM used in a variety of contexts	N/A

Analysis

The results of the interviews provided a general understanding of the experiences, goals, and challenges of those reusing the OER. Interview data and project

documentation were subsequently coded to identify links with concepts identified in the literature on innovation and OER described above, through a deductive thematic analysis approach.

Since innovation processes exist in a wider context of the goals, structures, and resources of the institutions, we do not attempt to identify causal links between B2S and subsequent innovations. Instead we identify how the OER initiative was seen to support innovations - whether realised, attempted, or speculated on - and the relevant drivers and barriers.

The sub-sections below relate key issues from the case study data to themes identified in the innovation literature reviewed previously.

Knowledge and Persuasion

Rogers (2010) highlights the importance of raising awareness of an innovation and of how this influences the development of attitudes toward it by potential adopters. Work to introduce the OER, and to devise effective uses of it with educators in their contexts, were critical to the initiative.

A project manager (PM) based at College 2 took on a significant role as a co-ordinator and advocate. The PM utilised their understanding of the context of US college study (including common barriers to entry) and of relevant institutional process. They specifically identified the potential of the OER to better prepare students for tests, and from this insight developed ways to be persuasive with educators:

“to ‘sell’ it to people (I tell them): It helps build students’ confidence... refreshes their mathematical thought process... no matter what any instructor will tell you ‘they are in algebra they don’t need to review that, well yes many students still do, and they are already scared enough as it is... and that is where we are losing them.... (SWiM) is remedial, but that remediation helps build their strength and their confidence”.

An unanticipated impact of the knowledge and persuasion work was an expansion beyond the original intended audience of college students. Further audiences included a vocational training program that required mathematics skills (non-profit 1), and a centre working with disadvantaged groups (non-profit 2). The PM noted that B2S could be an innovative solution to their challenges:

“I introduced B2S to the non-college course opportunities. I saw a direct link right away... [These students] do have the ability, but yes, they have deficiencies so this is to offset those deficiencies... I see these OER, specifically B2S...as a means to support those different learners who maybe aren’t matching to the instructor’s teaching style”.

All project partners played a role in spreading awareness by encouraging educators in their own institution and in others to consider using the materials. Knowledge of the provenance of the resources, and of the expertise involved in the remix process were persuasive elements mentioned by other interviewees. Knowledge also spread through inter-organisational staff networks. For example, the use of B2S content in

University 1 resulted from an existing relationship between staff members (one of whom had previously worked at College 1).

Decision, Implementation and Confirmation

Rogers (2010) describes activities leading to choices to adopt or reject the innovation. With regards to OER, this theme highlights the complexities of the diffusion process and the lack of a single 'decision' of adoption to be made. (For example, whether the use of the B2S OER was short, or sustained over time, the practical introduction to OER through the initiative was seen to prompt longer-term decisions to utilise OER more widely). In College 1, large institutional changes towards open online learning can be partly attributed to B2S (see "Substitution of Materials" below). In College 4, trust in the value of other OER shared by University 2 developed, with the interviewee stating:

"I don't think we've changed any policies but... it has increased awareness of what (University 2) has to offer... discussions have evolved about how we could use the different courses that (University 2) does offer and then how we increase awareness for our students".

Implementations could take the form of innovations to other institutional processes. For example in College 2, institutional data was used to identify students considered to be 'at risk', and they were then offered the B2S courses in a targeted way, in addition to their courses. This was a new approach to personalising provision to students.

Relative Advantages

This theme is apparent across the span of innovation literature: The Diffusion of Innovations model asks how an innovation is perceived to have advantages over the existing ideas it may supersede. Related to this, the SAMR model suggests different types of change to learning materials and activities. Identified links with these types of change are summarised below.

Substitution of Materials

The project played a role in prompting greater use of OER as a substitute for paid resources, which reduced costs of learning. This was most apparent in College 1, where it was noted that:

"we're trying as much as possible to put e-resources in every class and not require the students to buy additional materials... Bridge to Success kind of got us thinking... that these materials that are available, they're open, they are of good quality, and these are the kinds of things that we could embed in our courses".

Similarly, as an educator in College 7 noted:

"We share...Don't reinvent anything. Use what works...with our students... So we can always share in the resources that you come across. That is basically how we found out [about B2S]... [The B2S Project Manager] shared that with us. We don't

search out the sites, we just use what works best. Almost like a trial and error (where) we tried this and it didn't work, we tried this and it worked."

This substitution may seem a limited innovation with regards to the learning activity, but it can have other, more significant impacts (e.g., on costs of study). The substance of the innovation is of finance and access, rather than of pedagogy. These benefits would sit outside of the scope of the SAMR model with its pedagogical focus.

Augmentation of Materials

OER were often used to augment existing provision. This supported the infusion of hybrid and online learning into contexts where they had not previously existed. Activities or sections from the courses were "*cherry picked*" and used either in computer-based classes, or assigned to students for completion outside the classroom. In addition to facilitating alternative forms of delivery, OER use also provoked reflection on pedagogical practices and assumptions. An educator from University 1 described their augmentation of a course as follows:

"some students are not successful (and) they have to retake the course... I taught all of those students who failed ... and at the time it was basically the same course, the same syllabus, the same textbooks, everything all over again... My idea was that if this whole format wasn't successful, why am I teaching it doing exactly the same thing? [...] So what I did was I used some of the L2L materials as supplemental activities and I focused less on the required textbook".

Elsewhere, at College 4, L2L augmented current teaching by being given to students prior to starting a medical assistance programme. In this case the use of these course materials, which gave students opportunities to reflect on their learning, were noted to have "...definitely given more insight into ...[students'] different learning styles...".

Modification and Redefinition of Learning

In most cases, B2S courses were used within the context of established curricula and courses, and scope for effective integration of the OER varied. For example, the educator at University 1 noted that "*I couldn't entirely leave out the textbook... the course was written with the textbook in mind*". The OER was seen in some cases as a basis for modifying courses in the future, but this required buy-in and long-term processes of course approval. For example, discussing the use of L2L in a one-credit course at College 2, an educator stated that "*I'd love to see it be a three credit course*". They hoped in future to use extensive parts of the B2S OER as a basis to expand from the existing textbook-driven course. As an initial step, however, they could only introduce a limited number of the activities in class and direct students towards studying the OER informally as a supplementary learning opportunity.

Modifications to learning activities could be more easily implemented in non-profit contexts as these tended to be less restricted. At non-profit 1 and non-profit 2, computer labs had been set up, but there were limited educational resources available for specific purposes, such as preparation for a course entry test. These initiatives

were also funded for specific time periods, which amplified the need for an agile response to resource demands. Within this context OER provided a cost effective and easy to implement solution. The OER also prompted critical reflection on the wider student experience. An interviewee from College 1 noted that the project:

“got us thinking more about students when they come in the door - how do we help them? (Previously we may have only thought) ‘get them in the door, get them in the classes’, but you really need to help them think about where they are when they come in”.

This led to plans to provide OER prior to formal courses commencing.

The initiative also provided a basis for experimenting with new forms of learning. Having originally created and shared the OER during the project, University 2 then took the outcomes of this process as inputs to a further project that resulted in two of the first ‘Badged Open Courses’ (BOCs). These courses were produced as restructured versions of L2L and SWiM, with added challenges and reworked quizzes for accreditation. While this required significant additional work, it exemplifies the potential for OER to provide a basis for innovative forms of provision. These ‘forked’ adaptations were released in 2015 and are a success in both take up and relative completion rates. The BOC approach has continued to grow as a success, with a growing range of these courses available and more being developed in 2018.

Compatibility with Pre-Existing Systems and Difficulty to Learn

The relative advantages described above show how the OER were adopted in ways that were compatible with pre-existing curricula, technology, and organisational contexts. For balance, we focus here on barriers and limitations to adoption resulting from incompatibilities with institutional requirements and the prior skills of learners.

It was evident that there are limits to the flexibility of the OER to match curriculum requirements without creating significant adaptation requirements. Most strikingly, a lack of relevance of SWiM was identified in College 2, where staff noted that:

“we can find places where the curriculum matches, but it’s not our curriculum... to help students prepare for credit level math, that means a certain thing to us... Great content, but not at all aligned with what we do here”.

This lack of alignment led to SWiM not being used in earnest by this project partner, despite their involvement in adapting the content. While OER are highly mutable, this does not mean that any specific resource can become a suitable resource for any relevant curriculum, despite initial appearances. Further illustrative of the range of diverse needs that an OER may need to align with, two interviewees at College 7 were positive about the material but used other resources as B2S was “*more complex*” and not at the right level for all of their students. These students needed “*small, little chunks... and guided instruction*” rather than “*too many choices*” that they could not navigate independently. Although IT skills classes were freely available at College 7, the time needed to help students make use of the OER was perceived as a barrier to

widespread use by this instructor. B2S was perceived here as only appropriate *“for the excellent student that is self-motivated and going to drive themselves”*.

While materials were open to use without an account, educators were asked to encourage their students to sign up and log in, to provide both meaningful analytics to educators and the project, and additional study tools. These processes could be problematic, particularly where some students were unfamiliar with email. These can be seen as barriers, but are also a prompt for the development of digital literacies. The PM noted that external shifts towards greater use of technology in assessment were motivational:

“some of them are not computer savvy, and they know that this new computer test is coming up for GED (the General Educational Development examination taken in North America) and they know... that they will be one of the first to take it that way, so they see (using OER) as a real advantage”.

Considering issues of compatibility to pre-existing systems also highlights tensions between organisational norms and innovation driven by an advocate. In the case of B2S, innovation could be seen to emerge through individual educators, and through changes at organisational level. However organisational structures (as pre-existing systems) presented barriers to individual educators. In College 2 the interviewed educator hoped to expand the use of activities from L2L to increase the reflective component of their course. However, they needed to ask for an increase in formal course credits, otherwise the OER would remain an optional supplement that many students would not take the time to engage with. Such a change may take time to implement, or may not be agreed or supported by relevant staff. This suggests that it may be significantly easier to adopt OER as an augmentation within existing systems and structures. Arguably, this could be seen as less innovative than a fundamental disruption to current practices, though in this case it was a pragmatic starting point for adoption of OER. However, over time, as the concept and practice of OER use becomes more familiar, organisational norms may be more receptive to agile forms of innovation.

Testability and Observed Effects

Since OER are provided free of cost, and do not make any requirement to register or arrange access prior to use of the resources, it should be relatively easy to conduct trial adoptions to test out ways in which an educator or institution might make a wider adoption. The large range of organisations who rapidly adopted the B2S OER is testament to the ease of adoption for trial, but there are notable barriers in engaging time-poor educators to envisage useful implementations in the context of their pre-existing approaches. The PM noted that:

“you have to give them the experience... showing them how it worked and say ‘we have a similar curriculum, here it is’... I think that a challenge for any OER... They all know it’s out there now because it’s all been on the news with Khan Academy and MOOCs... but it’s still a challenge for people to take the time to dig in and see how...to use it”.

Open education also has a potential to be diffused between learners, outside of institutions and across generations. One highly self-motivated student at College 7 who had returned to college and was using SWiM noted that:

“other people see that I’m really into it... so they’re wanting to know about the programme... I work with my great nieces ... and walk them through it and everything, even though they’re younger I walk them through it so they can understand what’s going on when they’re in school. So they really like it”.

The capacity to observe effects and make causal links is complex for OER. The project team captured quantitative data and contextualised this where institutions were willing and able to collaborate, but this was in tension with the agility of OER, whereby resources can be quickly adopted in diverse ways. Institutional data on students is commonly closed, which reduces the ability to collaborate on evaluations of OER (Pitt, Ebrahimi, McAndrew & Coughlan, 2013). Instead, educators tended to make choices based on their perception of what is suitable for the students, and rationale can often be found for OER use. An educator from University 1, reported that:

“I do not have any quantitative data... I think this material, along with... other educational resources... did help my students... My students would rather have a computer in front of them than a book. L2L as part of an array of services did make a difference.”

Thus OER adoption can be rationalised by educators in terms of their individual understanding of their students, and their observed results. It may be that encouragement of individual experimentation and observation of effects can combine with general evidence on the effectiveness of OER (Hilton, 2016) to foster wider adoption.

Sustainability

While it is not a prominent theme in the models of innovation described above, the challenges of sustainability, in terms of maintaining OER use and OEP in organisations, have been highlighted by researchers such as Rolfe (2015) and Annand (2015).

New adoptions of the OER continued after the project end. However, the persuasion and knowledge building work largely ceased, and spread of the resources to new contexts slowed. Individual OER are often easy to obtain and experiment with (assuming the requisite skills and access to technology). However, their ubiquity may also mean they are easily abandoned and/or replaced. In non-profit 2, it was felt that funded proprietary resources needed to be used instead of OER, partly to show that the investment in these resources was valued/recouped. There was, however, expectation that OER would be considered for use again in the future, and in this sense it had become part of a corpus of resources. In non-profit 1, the end of the training initiative halted this specific use, but again, there was an expectation that this resource, and other OER, would be considered for use in the future, where appropriate.

When asked if they would continue to use the resources, an interviewee from University 1 responded: “I didn’t teach last semester... I am going to incorporate some

of them (when) I'm teaching in the summer and I don't know if I'm teaching in the fall". This highlights how uses of specific OER by a single educator could quickly end if an initial augmentation of a course does not infuse wider changes, or become embedded in stable curricula and staffing. While this may not be ideal, neither is it entirely fatal to OER as an innovation: sustainability of the use of OER can include serving short-term purposes while future developments are considered in parallel.

As OER are mutable, sustainability is multi-faceted and difficult to anticipate. One key example of this is the L2L and SWiM-based BOCs developed at University 2 and described previously. These 'forked' adaptations took substantial additional work, but their foundation was the B2S OER. Concomitantly, the increased preference for OER as a general approach at College 1, and for making students aware of trusted OER offerings at College 4, could be considered as a greater impact of the initiative than the sustained use of the B2S resources themselves.

Discussion

Our analysis suggests that existing models of innovation provide a starting point for understanding innovation in OER, but have limitations due to the multi-layered and indeterminate nature of OER. OER are more than a standard technological artefact of the type explained by the Task-Artefact Cycle or SAMR. Similarly, Rogers' model does not fully capture the complexity of what adoption means for such a multi-faceted phenomena. In the cases identified, the first steps of OER adoption were primarily driven by augmentation of existing courses with a specific resource. These could then potentially lead to a diverse range of innovations such as hybrid learning, curriculum innovation, and changes in pedagogy. More sustainable innovations developed as practices of choosing OER as a general approach, or to further work that takes an existing resource as a basis for a new learning experience. Based on this, we propose three types of innovation related to OER implementation.

1. Specific Adoption: Innovation with the use of a particular OER

OER afford individual educators the capacity to change their teaching more easily than would be possible with proprietary resources. This use of a specific OER supports forms of innovation that are 'little-c' creative responses to the challenges and opportunities identified by individual educators, such as offering a supplemental resource where the current course appears lacking. These innovations do not necessarily require organisational support or authorisation. However, they do require awareness and benefit from exemplars. Such innovations may be augmentations rather than redefinitions of learning, and a lack of institutional "buy-in" can inhibit further innovation, or prevent it from spreading to other educators in the institution. Sustainability can be problematic if, for instance, educators leave an institution or their teaching roles change. However, even when activities of this kind are ultimately short-lived, they can flow indirectly into or influence the other forms of innovation.

2. Preferred Practice: The innovation of engaging with OER as a general approach

Organisations or individuals can adopt the use of OER as a longer-term practice. For

instance, an educator may cease to use a particular OER but will proceed with a refined awareness of the possibilities offered by OER in the future. In such a case, OER as an innovation cannot be conceptualised as adoption of a specific artefact, but instead is an approach in which open resources are considered or prioritised when decisions about materials to use with students are made. While it may have identifiable pedagogical impacts, such as providing greater flexibility to the learner, such innovations may also impact on students through practical changes such as reducing costs. OER can also convey the idea of “openness” which can lead to productive reflection on wider open practices.

3. Foundations for Innovation: OER as a conduit or material for supporting other innovations

The use of OER provides the capacity for other educational innovations to develop or spread. A clear example of this in B2S was the introduction of hybrid approaches to learning, in which an online learning component (the B2S OER) was added to an existing face-to-face course. The resources themselves also acted as conduits of innovations to these existing courses, for example, introducing new forms of reflective activities from L2L into a study skills course at College 2.

OERs also provide material for creating new approaches to learning. Examples of this are the way in which the resources could be used to engage students between registration and course start date at College 1, and the Badged Open Courses created at University 2, which took the content of L2L and SWiM, adapted it, and added assessment and accreditation, to create a new learning experience. While such reuse has challenges, OER can be seen as a means of harnessing prior effort as a foundation for further innovation.

Modelling Innovation in the Context of an OER Initiative

These three forms of innovation are interrelated, with individual and organisational movements between them. They can be understood as three vectors of OER innovation. For example, a Specific Adoption of OER is a starting point for OER to become a Preferred Practice. A Specific Adoption or move towards Preferred Practice can provide a Foundation for Innovations, such as the introduction of hybrid learning, to be achieved. Our analysis has highlighted how aspects of the case study context drove or inhibited these types of movements. Figure 2 depicts the ways in which each was understood to drive or inhibit the others in the case of B2S. The relevant themes in the analysis, from which each driver and inhibitor has been derived, are noted in brackets.

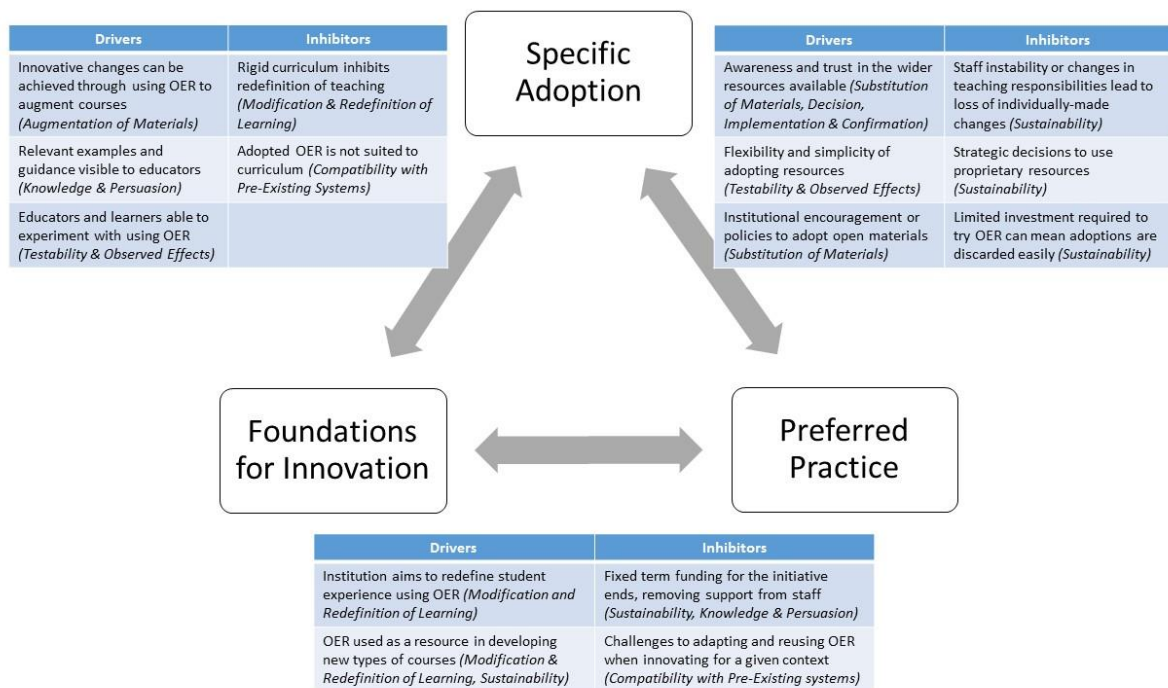


Figure 2: Forms of innovation in OER, showing the drivers and inhibitors between each form that were identified in the B2S case study. The drivers and inhibitors relate to the themes in the analysis noted in brackets.

Conclusion

According to Rogers, the speed of technology adoption can be described as a normal distribution with risk-taking “innovators” and “early adopters” at one end, and “laggards” at the other. The remainder are evenly split between early majority and late majority adoption. In this retrospective study of B2S, we could be largely observing the actions of “innovators” and “early adopters”. But the simplicity of Rogers’ curve belies a complexity of the nature of OER as an innovation, which suggests a more nuanced approach is needed. We may consider the adoption of openly-licensed resources as the essential innovation within OER that follows Rogers’ curve. But the understanding drawn from this case study identifies a range of innovative individual and organisational practices, alongside issues such as sustainability and change to the OER itself. We have therefore focused on the facilitation of subsequent innovation through OER activities.

It can be challenging to provide a convincing causal model which shows that innovations are linked to the open dimension of OER rather than arising from, say, digitization of resources. Methodologically, it is difficult to separate out the different dimensions of OER in this way. For this reason, we focused not on how elements of an OER initiative “cause” innovation to happen, but instead on how practitioners understood the impact of the OER-related activities with which they had been involved.

It might be thought that we place too much emphasis on the importance of OER content for innovation. Knox (2013) has for instance argued that the OER movement is too focused on the value of content and not enough on the resulting

pedagogical innovations and open educational practices. However, in this study we have found that the relevance of the OER courses themselves often acted as the catalyst for innovation. Furthermore, although we do not investigate open educational practices directly, the use of OER typically involves changes in practice. These may be relatively minor (e.g. finding and selecting OER for use in teaching but not changing anything else) or more far-reaching (advocating OER and engaging in more sophisticated remix and reuse behaviours). Since there is no widely agreed typology of open educational practices, we have not imposed such a schema.

It is also worth acknowledging that different institutions may have cultures which are more or less amenable to particular forms of innovation. Institutional cultures which identify as radical, agile or transformatory may act as incubators for open innovations, or facilitate the spread of an innovation across an organisation. Alternatively, it may be that risk-taking innovators in more conservative organisations are more likely to seek out opportunities shared from elsewhere, yet if the approach is not amplified by the institutional culture it is harder to sustain. It could be that there are some specific preconditions (e.g. the presence of an influential advocate, or a clearly agreed problem that OER has the potential to solve) for these innovations to become core preferred practices.

Our intention has not been to provide a context-transcendent account of open innovation: rather, we have provided detail on how a specific innovation was related to others, and shown how this can happen some time after the original intervention. Returning to, and reflecting on, the impact of past projects allows OER to be conceptualised in terms of both short-term actions and the potential for longer-term change. It also highlights how initiatives operate in a wider context of existing educational and technological innovations, and of individual and organisational development. The key message from this analysis is that innovation is linked with OER in multivalent, distinct ways. Analysis of further case studies using a similarly structured approach would lead to a structured knowledge base of drivers and inhibitors related to the forms of innovation inspired by OER. When planning or analysing OER initiatives – or exploring strategies for increasing their impact – consideration of the identified forms of innovation, and of the drivers and inhibitors acting between them, could be a fruitful form of collaboration which would enhance the validity of context-independent generalisations about innovation through OER.

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